4.1 GEOLOGICAL RESOURCES

This section discusses the potential geology issues that may be associated with the proposed Project. The information presented below outlines the environmental setting, regulatory setting, significance criteria, the potential for impacts to the facilities from various geological events (earthquakes, beach scour, etc.), and the significance of these impacts. This section also presents discussions of impacts associated with alternatives to the proposed Project as well as projects identified in the cumulative projects analysis.

4.1.1 Environmental Setting

Physiography

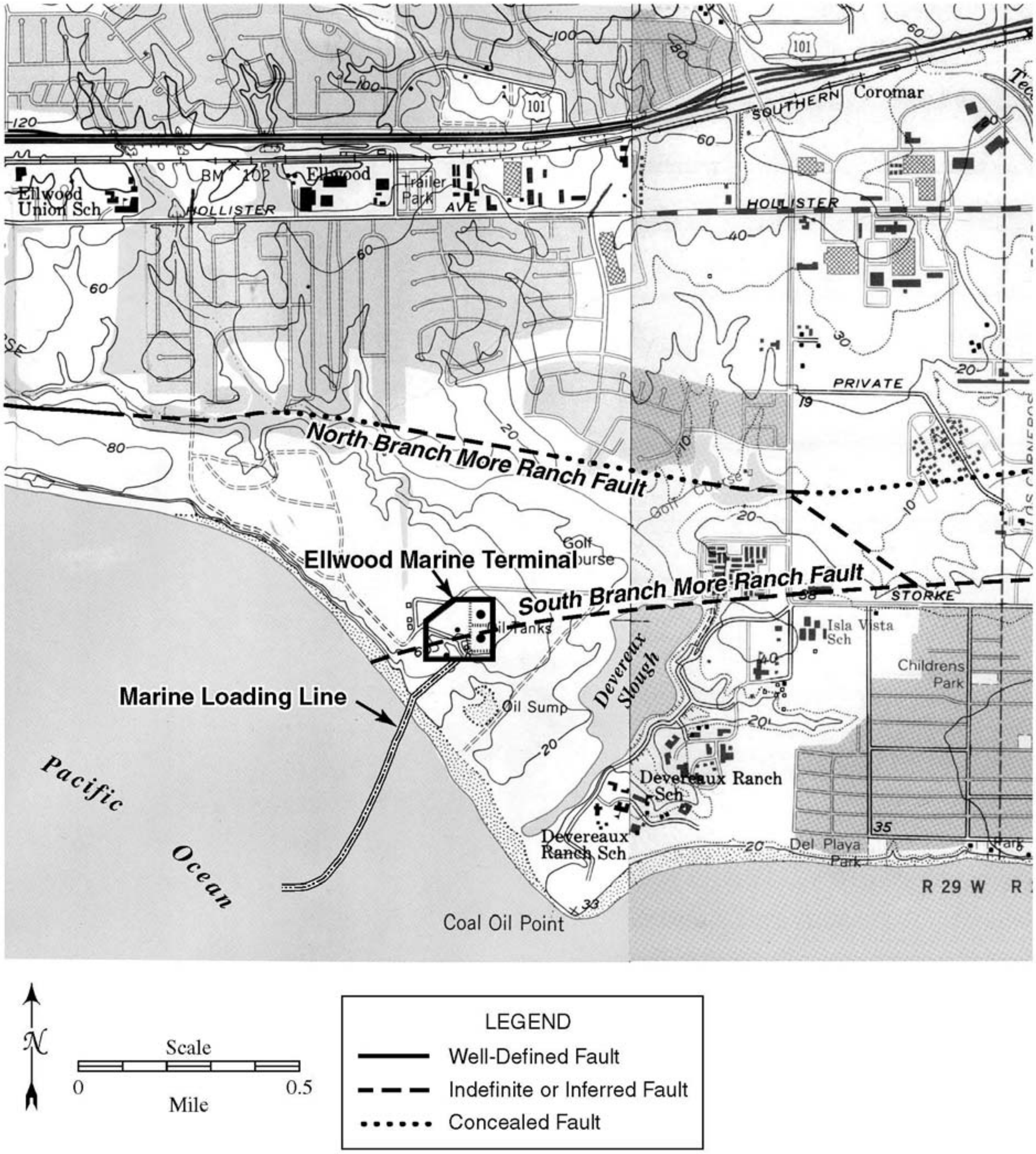
The onshore facilities of the Ellwood Marine Terminal (EMT) are situated on a coastal marine terrace, at an elevation of approximately 60 feet (18 meters [m]) above mean sea level (Figure 4.1-1). These facilities are located approximately 500 feet (150 m) northeast of a coastal bluff, approximately 800 feet (244 m) northeast of the Pacific Ocean, and approximately 1,000 feet (300 m) northwest of Devereux Slough. The topography at the site has been partially graded, resulting in relatively flat-lying areas on which the storage tanks, pump house, control room, and related infrastructure are located. However, a northwest-trending gully, approximately 20 to 25 feet (6 to 7.5 m) deep, is located in the southwest portion of the site. An earthen-fill dam has been constructed across the upper portion of the gully, creating a pond upstream of the dam.

From the EMT, the onshore portion of the marine loading line traverses the southeast-sloping coastal marine terrace, across active coastal sand dunes blanketing the approximately 20-foot-high (6-m) coastal bluff, and across a relatively flat beach area.

Stratigraphy

The onshore facilities are situated on Pleistocene older alluvium deposits, consisting primarily of relatively unconsolidated silt, sand, and gravel. These alluvial deposits overlie the Miocene Sisquoc Formation, which is exposed in the coastal bluff northwest of the project area and consists of silty, diatomaceous, clay shale. The majority of the onshore portion of the marine loading line similarly traverses older alluvium, underlain by Sisquoc Formation; however, the seaward 200 feet (60 m) of the pipeline is underlain by beach sand deposits (Dibblee 1987a).

Figure 4.1-1
Topography and Fault Map



Source: Base Maps: USGS 7.5 Min. Dos Pueblos and Goleta, California, 1952, 1988; Geology after Diblee 1987a, b; Gurrola et al. 1998, 2003; Hoover 1985; Minor et al. 2002.

Erosion And Scour

Scour, as discussed in this section, is defined as the removal of soil particles caused by concentrated surface water flow, in gullies or creeks, or by wave action along the oceanfront. Surficial soils across most of the site consist of artificial fill and the Concepcion series soils, which are moderately well-drained soils on low terraces that parallel the coastline. Artificial fill, consisting of a mixture of Concepcion series soils and underlying older alluvium deposits, is present in areas where the onshore site has been graded. Undisturbed areas are comprised of Concepcion series soils, which formed in mixed alluvium and consist primarily of grayish brown, fine sandy loam, approximately 19 inches (48 centimeters [cm]) thick. Existing onshore facilities at the EMT are located on gentle slopes, i.e., 0 to 2 percent slopes, where runoff is slow and the hazard of erosion and scour is slight. However, the marine loading line traverses moderately steep, eroded slopes, up to 30 percent, where runoff is medium to rapid and the hazard of erosion and scour is moderate to very high (USDA 1981). However, the majority of the marine loading line route is well vegetated, thus substantially reducing the potential for erosion and scour under existing conditions.

The seaward portion of the marine loading line traverses relatively loose dune and beach sand, which is generally prone to erosion and scour. Sands in the intertidal area are generally scoured off the beach during the winter months as a result of high surf activity, but then generally accrue during the summer months of gentle surf. Successive strong winter storm surf events, such as in 1978, 1983, 1996, and 1998, have periodically exposed the pipeline in the intertidal zone. For example, photographs and letters from Mr. David Sangster and Storrer Environmental, Inc., on file at the Santa Barbara County Energy Division illustrate that in February 1998, wave scour eroded the beach sand and sand dunes in the vicinity of the loading line, creating a 10- to 12-foot (3- to 3.5-m) vertical beach scarp along the sand dunes, which resulted in a section of pipe approximately 40 to 55 feet (12 to 16 m) in length becoming unsupported. These records illustrate that the length of the free span fluctuated daily as a result of fluctuating sand scour and subsequent accrual. In addition, photographs of the exposed pipeline and adjacent pipeline markers indicate that, as a result of erosive beach scour, the portion of the pipeline within the intertidal zone subsided approximately 3 feet (1 m) from February 1996 to February 1998.

Slope Stability

The topography at the onshore site is relatively flat; therefore, the potential for slope instability is low. Similarly, the topography along the majority of the marine loading line is relatively flat to gently sloping where it traverses the coastal marine terrace. The northern portion of the pipeline route traverses a northwest-trending gully, approximately 20 to 25 feet (6 to 7.5 m) deep, which consists of a steep northeast flank and gently sloping southwest flank. These slopes are very well vegetated and consist of massive, non-bedded, older alluvium deposits, with no evidence of prior slope instability. Therefore, the potential for slope instability under existing conditions is low. The loading line traverses a gently to moderately sloping coastal bluff, covered with well-vegetated, active sand dunes. The moderate gradient and abundant vegetation similarly creates a limited potential slope instability under existing conditions.

Faulting And Seismicity

Regional Seismicity

The Santa Barbara/Goleta area is located in the Western Transverse Ranges, a seismically active region of southern California. This area has experienced numerous seismic events over the last two centuries, including a few historic large-scale (magnitude greater than 6.0) events, such as the 1812 earthquake, which had a probable Richter magnitude of 7.1 (Toppozada et al. 1981) and likely occurred either offshore, on the San Cayetano Fault to the east (Dolan and Rockwell 2001), or on the Santa Ynez River Fault to the northwest (Santa Barbara County 2004; UCSB 2004; Sylvester and Darrow 1979). Other destructive earthquakes struck the Santa Barbara/Goleta area in 1857 (San Andreas Fault, magnitude 8.4), in 1925 (Santa Barbara vicinity, possibly the More Ranch or Mesa fault, magnitude 6.3), in 1927 (offshore Point Arguello, magnitude 7.3), and in 1978 (offshore North Channel Fault, magnitude 5.9).

Regional onshore faults that can be expected to cause seismic shaking at the EMT during an earthquake include the San Andreas Fault, located approximately 52 miles (83 km) from the site, and the Santa Ynez/Santa Ynez River Fault Zone, located approximately 10 miles (16 km) from the site. Both of these faults are considered active (Dibblee 1966; Jennings 1994; CDMG 1999). The San Cayetano blind thrust fault, located approximately 6 to 7 miles (10 to 12 km) beneath the project site, poses another significant seismic hazard (Namson and Davis 1988, 1990). The offshore Pitas Point/North Channel and Red Mountain faults, located approximately 5 miles (8 km) and

16 miles (26 km) offshore, respectively (Jennings 1994), are also considered active and would cause seismic shaking at the project site during an earthquake (Foxall et al. 1995). In addition, the Oak Ridge and Channel Islands faults pose significant offshore seismic sources (Shaw and Suppe 1994; Sorlein et al. 2000).

North Branch More Ranch Fault

The More Ranch Fault Zone traverses the project area. This fault zone consists of the South, Central, and Northern branches of the More Ranch Fault (a south-dipping reverse fault), which elevate the marine terrace on the Ellwood Mesa from the Goleta Valley to the north. These faults are visible in the sea cliffs and, in the case of the North Branch More Ranch Fault, have clear geomorphic expression. The North Branch More Ranch Fault was mapped by Dibblee (1987a, b) and Gurrola (et al. 1998, 2003) as trending approximately 0.4 mile (0.6 kilometer [km]) north of the project site (Figure 4.1-1). Dibblee (1966, 1987b) indicates displacement of both recent, i.e., Holocene, and older, i.e., Pleistocene, alluvial deposits along the North Branch More Ranch Fault. Holocene movement of this fault is suggested by north-facing fault scarps that are present on the east and west ends of this 9-mile-long (14-km) fault. The uplifted coastal mesas (Ellwood, Devereux, Isla Vista, University, and More Mesa) occur to the south of this fault as a result of fault movement.

The California Geological Survey (formerly the California Division of Mines and Geology [CDMG]) defines active faults as those along which movement has occurred within Holocene time (approximately the last 11,000 years). Potentially active faults display evidence of movement during Quaternary time (the past 1.6 million years). Inactive faults demonstrate no evidence of movement within Quaternary time (CDMG 1994). The Santa Barbara County General Plan Safety Element considers the More Ranch Fault(s) to be active. However, this fault zone has not been zoned as an active fault by the State of California (Jennings 1994; CDMG 1999). Based on sea cliff exposures, geomorphic expression, and oil well data, the North Branch More Ranch Fault is likely the most active structure in the More Ranch Fault System. Based on mapping by Gurrola (2003), the fault locally warps, folds, and faults a 45,000-year-old marine terrace platform and overlying alluvial sediments from Ellwood to More Mesa; therefore, Gurrola considers the fault potentially active.

The maximum projected earthquake magnitude of an earthquake along an active or potentially active fault may be calculated as a function of the total fault length or as a function of the fault surface area (Wells and Coppersmith 1994). Geologists have estimated a moment magnitude, i.e., a maximum expected earthquake, of magnitude

6.4 (Gurrola and Keller 1999) and a maximum credible earthquake of magnitude 6.8 (Hoover and Associates 1985). However, Gurrola et al. (2003) consider the More Ranch Fault as part of an extended fault system that includes the Mission Ridge-Arroyo Parida Fault System, which has a length of approximately 42 miles (70 km). Given a rupture length of 42 miles (70 km), the More Ranch-Mission Ridge-Arroyo Parida Fault System is capable of generating a maximum credible earthquake magnitude of approximately 7.2 (Santa Barbara County 2004; UCSB 2004).

The amount of seismically induced ground shaking is measured as ground acceleration, which is a function of earthquake magnitude, distance from the earthquake source, and rock and soil types present on the site, measured in percent of gravity (g). Some geologists have suggested that the More Ranch Fault could generate a peak bedrock acceleration of 0.80 g (Santa Barbara County 1997). A larger magnitude earthquake on an offsite fault would generate ground accelerations of approximately 0.75 g, as a function of distance from the project site (Hoover and Associates 1985). However, others have suggested a peak ground acceleration in the vicinity of the project site of 0.6 g, although higher peak accelerations can be generated locally (Mualchin 1996).

South Branch More Ranch Fault

The South Branch More Ranch Fault traverses the vicinity of the project site (Figure 4.1-1) (Gurrola et al. 1998, 2003; Minor et al. 2002). The exact location of this fault across the EMT is not well defined because its estimated location is based primarily on a review of 1928 aerial photographs; however, the fault offsets by up to 15 feet (4.5 m) a 45,000-year-old marine terrace on University of California, Santa Barbara property, west of Storke Road, as well as on the nearby sea cliff, and is therefore considered potentially active (Fugro West 2003; Gurrola et al. 2003).

Central Branch More Ranch Fault

Fault strands located between the North and South branches of the More Ranch Fault Zone have been designated by some geologists as the Central Branch More Ranch Fault. The state of activity of this branch is unknown, but the basal terrace deposits are offset by the fault on the Ellwood Mesa, suggesting that the Central Branch fault is also potentially active. However, Fugro West has identified short, discontinuous, potentially active faults approximately 500 feet (151 m) northwest of the project site and does not recognize these fault strands as part of the Central Branch More Ranch Fault (Fugro West 1996, 2003; Santa Barbara County 2004; UCSB 2004).

Liquefaction

Liquefaction is a type of ground failure that occurs as a result of loss of shear strength or shearing resistance in loose and sometimes medium dense, cohesionless soils, due to seismically induced ground shaking. Liquefaction typically occurs in sediments where ground water is less than 50 feet (15 m) below ground surface. The County of Santa Barbara identifies the Ellwood area as having a low to moderate liquefaction hazard (Moore, Taber, et al. 1979). However, areas of beach sand could have a high liquefaction potential, due to unconsolidated sand layers below the water table at shallow depths.

Other Types of Seismic Ground Failure

Differential settlement is a process whereby soils settle non-uniformly, potentially resulting in stress and damage to pipelines or other overlying structures. Such movement can occur in the absence of seismically induced ground failure, due to improper grading and soil compaction or discontinuity of naturally occurring soils; however, strong ground shaking often greatly exacerbates soil conditions already potentially prone to differential settlement, resulting in distress to overlying structures. Elongated structures, such as pipelines, are especially prone to damage as a result of differential settlement.

Lateral spreading is a type of seismically induced ground failure that occurs when cracks and fissures form on an unsupported slope, resulting in lateral propagation and failure of slope material in a downslope direction. This type of failure is common in unconsolidated river or stream bank deposits, where lateral stream scour creates oversteepened banks in unconsolidated silts and sands. However, the steep slope along the southwest onshore portion of the EMT, which appears to be at least partially composed of artificial fill deposits, as well as the slopes of the oil tank containment berms, may be subject to lateral spreading in the event of a strong earthquake in the vicinity of the site.

Natural Oil Seeps

Prolific natural hydrocarbon seepage occurs offshore of Coal Oil Point in the Santa Barbara Channel. The seeps emit both liquid and gaseous hydrocarbon phases, with gas predominating. The most active gas seeps form visible boils where they intersect the sea surface. Such hydrocarbon seepage affects ocean chemistry and provides a natural source of petroleum pollution. Submarine venting of methane, a greenhouse gas, may provide a substantial and overlooked source of methane in the environment. On a regional scale, the Coal Oil Point seeps represent a significant source of gaseous hydrocarbons and residual asphaltic hydrocarbons, or beach tar. Chemical analysis of air grab samples collected from airplanes over the Santa Barbara Channel suggests that geogenic sources of hydrocarbon trace gases, i.e., natural seeps, dominate over anthropogenic sources, i.e., automobile emissions, and that 86 percent of the nonmethane hydrocarbons in these samples originated from natural seeps. In 1990, the emission rates from the Coal Oil Point seeps were equal to twice the emission rate from all the on-road vehicle traffic in the County. The natural hydrocarbons seeps in the Santa Barbara Channel are also the principle source of dissolved methane in the California Current (Quigley et al. 1999; Hornafius et al. 1999).

The Miocene diatomaceous shale and siltstone of the Monterey Formation are the source for the seep emissions. The nearshore seeps at Coal Oil Point are predominantly oil exuded directly from the outcrop of the Monterey Formation. Further offshore, seepage passes through overlying Sisquoc Formation cap rock and includes both oil and gas. The offshore seepage is controlled by the local geologic structure, which trends west-northwest. Seepage is most intense at submarine fault conduits and at structural closures along anticline axes (Quigley et al. 1999; Hornafius et al. 1999).

At one structural closure along the South Ellwood anticline, a site of intense historical seepage, offshore oil production occurs at Platform Holly. At a second closure, 1 mile (1.5 km) east of Platform Holly, prolific gaseous seepage is captured by a pair of seep tents. The aerial distribution and volume of seep emissions have varied. Time variation in the seep emissions is a significant issue, because it implies variability in the local background levels against which pollution from industrial activities are measured. A time series of average monthly seep gas emission volumes collected at the seep tents illustrates the variability in the seep emissions. Some variations in seepage could result from natural effects, e.g., changes in the fracture migration pathways due to viscous tar sealing or seismic activity. However, these effects likely account for only second-order variations. The dominant trend is most likely attributable to the effect of oil production on the reservoir pressure that drives seepage. The disappearance of seepage around Platform Holly and decline in emission volumes collected at the adjacent seep tents indicate a long-term decline in seepage. That the observed reductions in seepage are spatially associated with oil production from Platform Holly suggests that the decline in seepage between 1973 and 1995 is associated with effects of oil production (Quigley et al. 1999; Hornafius et al. 1999).

Sampling and geochemical analysis of beach tar balls and oil from offshore drilling platforms have been completed along the coast from Santa Barbara north to Point Sal (Lorenson et al. 2004). The study concluded that samples collected from Platform Holly oils have biomarker parameters that are similar to seep oils. In contrast, all of the platform oil samples collected from offshore Point Arguello, including Platforms Harvest, Hermosa, Hidalgo, and Irene, demonstrated higher thermal maturity than tar balls collected on Surf Beach. Higher thermal maturity would be expected from production oils, which are pumped from deeper levels and have experienced more thermal maturation. All beached tar balls share geochemical characteristics typical of source rock in the near-surface Monterey Formation, which contains heavy, low-grade petroleum that formed under low-thermal-maturity conditions.

4.1.2 Regulatory Setting

Federal

The Uniform Building Code (UBC) defines different regions of the United States and ranks them according to their seismic hazard potential. There are four categories of these regions, designated as Seismic Zones 1 through 4, with Zone 1 having the least seismic potential and Zone 4 having the highest seismic potential. The project area is located within Seismic Zone 4; accordingly, any future development would be required to comply with all design standards applicable to Seismic Zone 4.

State

California Building Code

The State of California provides a minimum standard for building design through the California Building Code (CBC), which is based on the UBC, but has been modified for California conditions. The CBC is selectively adopted by local jurisdictions, based on local conditions. The project area is also located within Seismic Zone 4 of the CBC (Moore, Taber, et al., 1979).

Chapter 23 of the CBC contains specific requirements for seismic safety. Chapter 29 of the CBC regulates excavation, foundations, and retaining walls. Chapter 33 of the CBC contains specific requirements pertaining to site demolition, excavation, and construction to protect people and property from hazards associated with excavation cave-ins and falling debris or construction materials. Chapter 70 of the CBC regulates grading activities, including drainage and erosion control. Construction activities are subject to occupational safety standards for excavation, shoring, and trenching, as specified in the State of California Division of Occupational Safety and Health (commonly called Cal/OSHA) regulations (Title 8 of the California Code of Regulations) and in section A33 of the CBC.

The Alquist-Priolo Special Studies Zones Act of 1972

The criteria most commonly used to estimate fault activity in California are described in this act, which addresses only surface fault-rupture hazards. The legislative guidelines to determine fault activity status are based on the age of the youngest geologic unit offset by the fault. An active fault is described by the CDMG as a fault that has "had surface displacement within Holocene time (about the last 11,000 years)." A potentially active fault is defined as "any fault that showed evidence of surface displacement during Quaternary time (last 1.6 million years)." This legislation prohibits the construction of buildings used for human occupancy on active and potentially active surface faults. However, only those potentially active faults that have a relatively high potential for ground rupture are identified as fault zones. Therefore, not all potentially active faults are zoned under the Alquist-Priolo Earthquake Fault Zone, as designated by the State of California.

The Seismic Hazards Mapping Act

These regulations were promulgated for the purpose of promoting public safety by protecting against the effects of strong ground shaking, liquefaction, landslides, other ground failures, or other hazards caused by earthquakes. Special Publication 117, Guidelines for Evaluating and Mitigating Seismic Hazards in California (CDMG 1997), constitutes the guidelines for evaluating seismic hazards other than surface fault-rupture, and for recommending mitigation measures as required by Public Resources Code (PRC) section 2695(a). However, to date the California Geological Survey (CGS) has not zoned offshore California under the Seismic Hazard Mapping Act. Therefore, this act does not apply to this Project.

California Coastal Act

The California Coastal Air Act (Coastal Act) of 1976 created the California Coastal Commission (CCC) and six area offices, which are charged with the responsibility of granting development permits for coastal projects and for determining consistency between Federal actions and State coastal management programs. Also in 1976, the State legislature created the California State Coastal Conservancy to take steps to preserve, enhance, and restore coastal resources and to address issues that regulation alone cannot resolve. The Coastal Act created a unique partnership between the State (acting through the CCC) and local government to manage the conservation and development of coastal resources through a comprehensive planning and regulatory program. The CCC uses the Coastal Act policies as standards in its coastal development permit decisions and for the review of local coastal programs, which are prepared by local governments. Among many issues, the local coastal programs require protection against loss of life and property from coastal hazards, including geologic hazards. This requirement is implemented locally through the Santa Barbara County Comprehensive Plan, Seismic Safety and Safety Element.

California State Lands Commission - Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS)

The MOTEMS were approved by the California Building Standards Commission on January 19, 2005. These standards apply to all existing and new marine oil terminals in California, and include criteria for inspection, structural analysis and design, mooring and berthing, geotechnical considerations, fire, piping, mechanical and electrical systems. The purpose of MOTEMS is to establish minimum engineering, inspection and maintenance criteria for marine oil terminals in order to prevent oil spills and to protect public health, safety and the environment.

Local

Conformance with the County of Santa Barbara's Grading and Building Codes are considered generally satisfactory (by the County), with respect to geologic hazards; however, select amendments are recommended in the County General Plan Seismic Safety and Safety Element (Moore, Taber, et al., 1979). This document recommends that an adequate site-specific investigation be performed where the possibility of soil or geologic problems exist.

4.1.3 Significance Criteria

Impacts are considered significant if any of the following conditions apply:

- Settlement of the soil, beach scour, or slope instability that could substantially damage structural components of the EMT;
- Deterioration of structural components of the EMT due to corrosion, weathering, fatigue, or erosion that could reduce structural stability;

- Ground motion due to a seismic event that could induce liquefaction, differential settlement, or lateral spreading that could damage structural components;
- Damage to petroleum pipelines and/or valves along the pipeways from any of the above conditions that could release crude oil into the environment; or
- Erosion induced siltation of nearby waterways as a result of ground disturbing activities.

4.1.4 Impact Analysis and Mitigation

The Project is expected to have a less than significant impact or no impact associated with the environmental issues identified below.

Potential slope instability would be limited to surficial sloughing during ground-disturbing activities; therefore, the integrity of the pipeline would not be compromised as a result of slope instability during the lease renewal period.

Geologic impacts of the proposed Project are primarily associated with potential facilities failure resulting from an earthquake, corrosion, or beach scour. Geologic impacts are also associated with pipeline replacement activities, which would be needed for maintaining the pipeline and related facilities over a longer lifetime. In addition, geologic impacts would include remediation activities associated with potential pipeline rupture and resultant oil spills. The following describes these geologic impacts associated with the proposed Project.

Impact GEO-1: Slope Failures

Ground-disturbing pipeline replacement activities and/or oil spill remediation may cause localized sloughing of unconsolidated alluvial sands, artificial fill, and dune sands (Less Than Significant, Class III).

Impact Discussion

No new grading, excavations, or construction would occur in association with the proposed Project. However, lease renewal would extend the risk of geologic disturbance. The majority of the pipeline route is above ground, thus reducing the potential for ground disturbance during routine maintenance and pipeline replacement activities. However, such activities and/or oil spill remediation activities may result in vegetation removal and excavations on the steep northeast gully slope, located immediately southwest of the EMT. Such activities could result in sloughing of unconsolidated alluvial and/or artificial fill deposits. However, sloughing would likely be shallow and localized and would likely not affect the integrity of the pipeline because it is elevated on stanchions that are grounded in the base of the gully. Similarly, localized sloughing of unconsolidated dune sands may occur during pipeline replacement activities and/or oil spill remediation activities. However, the slope gradient is moderate where the pipeline traverses the dune sands and no gross slope failures, which might impair the integrity of the pipeline, are expected. Therefore, potential slope stability impacts would be less than significant (Class III).

Impact GEO-2: Damage to Facilities Due to Beach Scour

Beach scour could substantially damage structural components of the EMT (Potentially Significant, Class II).

Impact Discussion

Successive strong winter storm surf events, such as those in 1978, 1983, 1996, and 1998, have periodically exposed the pipeline in the intertidal zone, resulting in unsupported free-span sections of pipeline of up to 40 to 55 feet (12 to 16 m) in length, as well as pipeline settlement up to 3 feet (1 m). Calculations done by the Santa Barbara County Building and Safety Division indicate that the marine loading line is vulnerable to damage if the free-span distance exceeds 30 feet (9 m). Pipeline cathodic protection tests, guided ultrasonic surveys (GUL) of the exposed portions of the pipeline, and hydrotests were performed on the loading pipeline, subsequent to pipeline exposure up to 55 feet (16 m) in 1998. These tests determined that the pipeline did not suffer any structural damage, excessive corrosion or leaks as a result of the unsupported section of pipeline (Santa Barbara County Energy Division 1999). However, in the future, pipeline free-spans in excess of 30 feet (9 m) and scour-induced pipeline settlement could result in structural damage and rupture of the pipeline. Therefore, potential impacts due to wave scour would be significant.

Mitigation Measure

GEO-2a. Marine Loading Line Free-Span Monitoring. Consistent with recommendations by the County Energy Division (Santa Barbara County Energy Division 1999) and the California State Lands Commission (CSLC) Engineering Department, the marine loading line shall be monitored after winter storms for exposure, debris impact, and for unsupported spans.

> Should the pipe free span approach 30 feet (9 m) in the future, remedial actions, e.g., sandbags beneath the pipe, permanent pipe supports, evacuating the line, etc., shall be implemented to maintain the integrity of the line. In addition, assessment of the strains on the pipeline due to settling should be conducted when the pipeline is exposed and any additional supports should be added at that time.

Rationale for Mitigation

It was determined by the Santa Barbara County Energy Division and the CSLC that the uncovering of the pipeline section located on the beach with heavy machinery would produce significant environmental impacts. Therefore, it was decided that the Applicant would wait till the pipeline is uncovered naturally, e.g., as a result of a storm. Mitigation Measure (MM) **GEO-2a** would minimize potential stress on the marine loading line resulting from unsupported pipeline sections and pipeline settlement created by wave-induced beach and dune scour. Reducing stress on the pipeline would reduce potential for pipeline failures, and subsequent oil spills.

Prior exposure of the pipeline in the beach areas created unsupported spans. Analysis, conducted by the Applicant and the Santa Barbara County Energy Division, indicated that the spans did not exceed good engineering practices. However, some settling of the pipeline could have occurred and this could have introduced strains on the pipeline that could compromise the pipeline integrity. The proposed engineering analysis would determine the impact of pipeline settling on the pipeline integrity. Timely identification of any pipeline stress would allow for repairs or installation of supports to the pipeline and would reduce risk of pipeline failure from the identified stress, and thus reduce probability of an oil spill.

Impact GEO-3: Facilities Damage due to Corrosion

Weathering-induced corrosion could substantially damage structural components of the EMT (Potentially Significant, Class II).

Impact Discussion

The marine loading line is located immediately above ground from the pump house to the sand dunes, and is buried from the sand dunes into the surf zone. The loading line is coated externally and equipped with cathodic protection. In the surf zone area, portions of the pipe are covered with a mastic covering and wrapped with 10-inch-wide

(25-cm), all-weather pipe wrap to the 10-inch (25-cm) flange, and portions are coated with 0.06-inch-thick (0.2 cm) Tru-Coat plastic coating. However, inspections of the pipeline after exposures in 1996 and 1998 showed that the buried section of the pipeline contains areas with missing or damaged coating that have been exposed extensively to salt water. In addition, this section of the pipeline may currently be at an elevation below the water table, as it was in the summer of 2001 (Santa Barbara County Energy Division 2002). Although corrosion of the pipeline is mainly controlled by the cathodic protection, the portion of the loading line that is missing the coating and wrapping is particularly susceptible to corrosion and associated pipeline leaks.

Monthly testing completed by the Applicant for the marine loading line has demonstrated that the pipeline has adequate cathodic protection. In addition, the Applicant completed GUL inspections of the marine loading line in June 2001 and April 2002. The GUL inspections indicated that there is no active corrosion in the pipeline; however, the tests were not completed on the buried portion of the pipeline (Santa Barbara County Energy Division 2002), which is most susceptible to corrosion. The GUL testing of the pipeline that detects internal and external corrosion can only be performed, with 100 percent certainty in results, on the exposed portions of pipelines.

In addition, other structural components of the EMT are exposed to weathering and have the potential to leak. For example, the EMT tanks have recently undergone significant repairs due to corrosion-related issues on both tanks. Therefore, potential corrosion-related impacts would be significant (Class II).

Mitigation Measure

GEO-3a. Loading Line Corrosion Monitoring. Consistent with recommendations by the County Energy Division (Santa Barbara County Energy Division 2002) and the CSLC Engineering Department, the marine loading line shall be monitored after winter storms. In the event that the line is exposed by winter beach scour, the Applicant shall inspect the line with GUL and confirm thickness of problem areas with ultrasonic testing technology. The Applicant shall re-coat and re-wrap all segments of the line damaged or missing pipeline coating. In addition, the remaining unexposed portion of pipe in the intertidal area shall similarly be excavated (preferably with hand tools), inspected, tested, re-wrapped, and re-coated. In addition, other structural components of the EMT, including the tanks, connecting pipelines, and valves shall be monitored for corrosion-related damage. This maintenance should be conducted on the pipeline if pipeline exposure does not occur within the next 5 years. The loading pipeline testing and inspection program shall comply with MOTEMS.

Rationale for Mitigation

MM GEO-3a would minimize potential corrosion-induced damage of the marine loading line created by burial within the intertidal zone and of the structural components of the EMT, and therefore reduce potential for line failure and subsequent oil spills.

Impact GEO-4: Erosion of Drainages

Ground-disturbing pipeline replacement activities and/or oil spill remediation could result in increased erosion and sedimentation of local drainages (Potentially Significant, Class II).

Impact Discussion

Routine maintenance, pipeline replacement, and/or oil spill remediation activities may result in vegetation removal and excavations, which may cause an increased potential for short-term erosion and sedimentation of a nearby dune swale pond, a surrounding wetland, and Devereux Slough, located approximately 400 to 500 feet (120 to 150 m) southeast and topographically downgradient from the onshore EMT and its associated marine loading line, at the closest point. While these activities pose the same risk under current operations, the extension of the life of the facilities due to the proposed Project would extend the potential for these types of disturbances. Therefore, erosional impacts would be potentially significant (Class II).

Mitigation Measure

GEO-4a. Erosion Control Measures. Best Management Practices (BMPs) such as temporary berms and sedimentation traps, including silt fencing, straw bales, and sand bags, shall be installed prior to work involving ground disturbance. The BMPs shall include maintenance and inspection of the berms and sedimentation traps during rainy and non-rain periods, as well as re-vegetation of impacted areas. Re-vegetation shall address plant type as well as monitoring to ensure appropriate covering of exposed areas.

Rationale for Mitigation

MM GEO-4a would minimize erosion-induced sedimentation, caused by ground-disturbing activities, at a nearby dune swale pond, a surrounding wetland area, and Devereux Slough.

Impact GEO-5: Faulting and Seismicity

Seismic activity along the More Ranch Fault Zone or other regional faults could produce fault rupture, seismic ground shaking, liquefaction, or other seismically induced ground failure that would expose people and structures to greater than normal risk during the lease period (Potentially Significant, Class II).

Impact Discussion

As illustrated by Figure 4.1-1, the South Branch More Ranch Fault traverses the EMT. The exact location of this fault in the vicinity of the project site is not well defined; however, exposures of this fault to the west and east of the project site indicate that the fault is potentially active. Only in the past 7 years has this fault branch been recognized as traversing the project site (Gurrola et al. 1998, 2003). In addition, the North Branch More Ranch Fault is located approximately 0.4 mile (0.6 km) north of the EMT. This fault is considered active, and it would be more likely than the South Branch More Ranch Fault to rupture and create strong seismically induced ground shaking at the project site.

Strong-to-intense ground shaking due to an earthquake on these or other regional active faults could result in differential settlement, lateral spreading, and localized liquefaction, resulting in potential damage to and/or rupture of EMT facilities. Earthquake-related hazards, such as liquefaction, ground rupture, ground acceleration, and ground shaking cannot be avoided in the Santa Barbara/Goleta region and in particular in the vicinity of the More Ranch Fault.

The EMT was constructed in 1929, and seismic integrity testing and/or seismic retrofitting has not been completed since construction, thus increasing the vulnerability of the facility to seismically induced damage. The Santa Barbara County Energy Division maintains a Systems Safety and Reliability Review Committee (SSRRC) to identify and require correction of possible design and operational hazards for oil and gas projects. The goal of the SSRRC is to substantially reduce the risks of project-related hazards that may result in loss of life and injury and damage to property and the natural environment. The SSRRC is delegated authority to review the technical design of facilities, as well as to review and approve the Safety, Inspection, Maintenance and Quality Assurance Program (SIMQAP) and its implementation, e.g., conduct safety audits, review facility changes, etc. (Santa Barbara County Energy Division 2005). A review of SIMQAP files indicates that seismic integrity testing and/or seismic retrofit activities have not been completed at the EMT. The Santa Barbara County Fire Prevention Division indicated that seismic studies had not been completed at the EMT, as part of the California Accidental Release Program (Cal ARP), because there are no combustible gases or highly toxic regulated materials stored at the facility (Bishop 2005).

Seismic hazards are common to the Santa Barbara region and are not increased by the Project. However, because the project area is underlain by a newly identified strand of the potentially active South Branch More Ranch Fault, and the active North Branch More Ranch Fault is only 0.4 mile (0.6 km) north of the EMT, there is a greater than average risk of seismic impacts, especially to the crude oil storage tanks (Class II).

Mitigation Measure

GEO-5a. **Seismic Inspection.** The Applicant shall cease terminal operations and inspect all EMT pipelines and storage tanks following any seismic event in the region (Santa Barbara County and offshore waters of the Santa Barbara Channel and Channel Islands) that exceeds a Richter magnitude of 4.0. The Applicant shall report the findings of such inspection to the CSLC and the SSRRC and shall not reinstitute operations of the EMT until authorized to do so by the CSLC.

In addition, implement **MM HM-1a** (Reduced Crude Oil Hydrogen Sulfide Content) and **HM-1b** (EMT Tank Maintenance Program) identified in Section 4.2, Hazards and Hazardous Materials.

Rationale for Mitigation

MM GEO-5a would reduce seismically induced impacts caused by a rupture on a nearby or regional fault by identifying failed components prior to resuming terminal operations. **MM HM-1a** and **HM-1b** would reduce the probability of a storage tank failure, and minimize potential impacts to public health in the event the storage tank fails during a seismic event.

Table 4.1-1
Summary of Geological Resources Impacts and Mitigation Measures

Impact (Impact Class)	Mitigation Measures
GEO-1: Slope Failures (Class III).	None required.
GEO-2: Damage to Facilities Due to Beach Scour (Class II).	**GEO-2a.** Marine Loading Line Free-Span Monitoring.
GEO-3: Facilities Damage due to Corrosion (Class II).	**GEO-3a.** Loading Line Corrosion Monitoring.
GEO-4: Erosion of Drainages (Class II).	**GEO-4a.** Erosion Control Measures.
GEO-5: Faulting and Seismicity (Class II).	**GEO-5a.** Seismic Inspections.

4.1.5 Impacts of Alternatives

No Project Alternative

Overall, impacts would be less than those described for the proposed Project. Potential erosional impacts would be greater because abandonment of the facility would result in substantial ground disturbance during removal of storage tanks, pipelines, and related infrastructure, however, these impacts would be addressed in a separate CEQA document. In addition, excavation of potentially contaminated soil would result in short-term exposure of sediments to erosion. However, potential sedimentation impacts to the dune swale pond and Devereux Slough would be short-term, pending re-vegetation, and could be minimized through facility abandonment during the dry summer months and implementation of standard erosion control measures during the subsequent rainy season. Erosion related impacts would be potentially significant (Class II), but mitigable by implementation of **MM GEO-4a**.

Truck Transportation

Impacts would be similar to those described for the No Project Alternative, since the EMT would no longer be required and the facility would be abandoned. No geologic impacts would occur as a result of transport of crude oil in trucks to Carpinteria.

Pipeline Transportation

Impact GEO-6: Erosion and Siltation of Waterways

Potential erosion-induced siltation of nearby waterways and slope stability impacts (Potentially Significant, Class II).

Impact Discussion

Overall, impacts would be less than those described for the proposed Project. Seismic impacts would be less for this option because the pipeline would not traverse any active or potentially active faults along the alignment. However, the pipeline would similarly be subject to strong seismically induced ground failure, corrosion, and erosive stream scour.

Potential erosion-induced sedimentation of local creeks and drainages would be greater because substantially more ground disturbance would occur in association with this option as a result of pipeline excavations and backfilling activities. En route to Las Flores Canyon, the pipeline would traverse several creeks that could be impacted by pipeline construction.

Potential slope stability impacts would be greater under this method of crude oil transportation because the pipeline alignment would traverse several steep hillsides, including those underlain by the highly unstable Rincon Shale Formation. However, such impacts would be mitigable through standard geotechnical engineering. Overall, geologic impacts would be significant but mitigable (Class II). If this method of crude oil transportation is selected, a more detailed geologic impacts evaluation would be necessary as part of a separate CEQA review.

Mitigation Measure

Implementation of **MM GEO-4a** identified for the proposed Project. In addition, implementation of:

GEO-6a. Slope Stability Measures. Prior to construction, the Applicant shall complete a geotechnical investigation along the proposed pipeline route. The geotechnical investigation and associated recommendations shall be prepared by both a licensed geotechnical engineer and an engineering geologist to verify that slope stability measures comply with the existing geologic setting and current Uniform Building Code (UBC) grading standards. Based on the results of the investigation, standard engineering construction-related slope stability measures, such as establishment of acceptable temporary cut slope angles, and standard operational slope stability measures, such as installation of slope inclinometers on steep slopes subject to soil creep, shall be implemented in the project design as needed to minimize impacts associated with potential slope failure. Operational slope stability measures shall also include annual monitoring of slope conditions by a licensed engineering geologist after the rainy season, i.e., after April 15, to document any potential changes in slope conditions and recommend remedial measures, as necessary.

Rationale for Mitigation

MM GEO-4a would minimize erosion-induced sedimentation, caused by ground-disturbing activities, and **MM GEO-6a** would identify the need for and incorporate into the project description any standard engineering construction-related measures required to minimize potential slope instability and associated pipeline damage during construction and operational phases of the proposed pipeline.

4.1.6 Cumulative Projects Impact Analysis

The proposed Project and several of the contemporary projects would involve repair and maintenance activities, which would require ground-disturbing activities that could result in erosion and possible sedimentation. Ground disturbance and potential erosion associated with the proposed Project would likely be localized and limited in scope. Potential erosional impacts due to sedimentation in the nearby dune swale pond and Devereux Slough can be reduced to less than significant levels through implementation of standard erosion-control measures. Although ground disturbance associated with facility repairs or soil remediation may occur simultaneously with construction of other cumulative projects, implementation of standard erosion-control measures at each project site would similarly minimize cumulative erosion and sedimentation impacts to less than the significance criteria. See Section 4.4, Hydrology, Water Resources, and Water Quality, for additional information regarding other potential cumulative water quality impacts to Devereux Slough.

Structural development of individual projects is subject to code requirements of the Uniform Building Code and would be completed in accordance with recommendations by a licensed geotechnical engineer and the County Public Works Department. Therefore, impacts associated with cumulative projects in the vicinity of the site would generally be site-specific and less than significant. Impacts to human health associated with potential large oil spills from the EMT are addressed in Section 4.2, Hazards and Hazardous Materials.